# Management of configuration for Protection Systems at ESS

M. Carroll†, G. Ljungquist, M. Mansouri, D. Paulic, A. Nordt European Spallation Source, Lund, Sweden
Protection Systems Group, Integrated Control System Division

## ABSTRACT

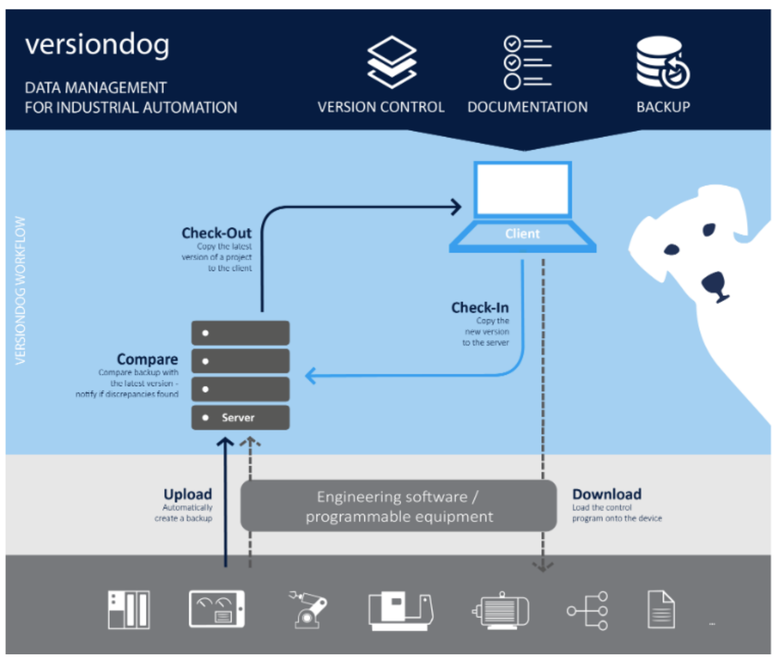
The European Spallation Source (ESS) in Sweden is one of the largest science and technology infrastructure projects being built today. The facility design and construction includes the most powerful linear proton accelerator ever built, a five-tonne, helium-cooled tungsten target wheel and 22 state-of-the-art neutron instruments. The Protection Systems Group (PSG), as part of the Integrated Control Systems (ICS) Division at ESS, are responsible for the delivery and management of all the Personnel Safety Systems (PSS) and Machine Protection Systems (MPS), consisting of up to 30 PSS control systems and 6 machine protection systems. Due to the bespoke and evolving nature of the facility, managing the configuration of all these systems poses a significant challenge for the team. This paper will describe the methodology followed to ensure that the correct configuration is correctly implemented and maintained throughout the full engineering lifecycle for these systems.

**Configuration Item Document List (CIDL)**

| System Requirement Specification | | |
|---|---|---|
| **ID** | **Source** | **Requirement** |
| SRS-001 | SIF-001 | 'System' shall notify system x when input y is over threshold z. |

| Detailed Design Specification | | |
|---|---|---|
| **ID** | **Source** | **Requirement** |
| DDS-001 | SRS-001 | read ai from y on I001.1 & I001.2 |
| DDS-002 | SRS-001 | perform diagnostic on input signals…. |
| DDS-003 | SRS-001 | scale input values, displays on OPI |
| DDS-004 | SRS-001 | Store constants for high limits |
| DDS-005 | SRS-001 | read reset signal from the OPI |
| DDS-006 | SRS-001 | check input values (DDS-001) are below constants (DDS-004) |
| DDS-007 | SRS-001 | energise output for Q001.1 when (DDS-006) is true, (DDS-002) no error, when (DDS-05) is pressed. |

| Test Specification | | |
|---|---|---|
| **Test Steps** | **Source** | **Test Description** |
| 1.1,2,3… | DDS-001 | verify ai inputs I001.1 & I001.2 |
| 2.1,3,3… | DDS-002 | verify diagnostics (wire break etc.) |
| 3.1,2,3… | DDS-003 | verify scaling functions |

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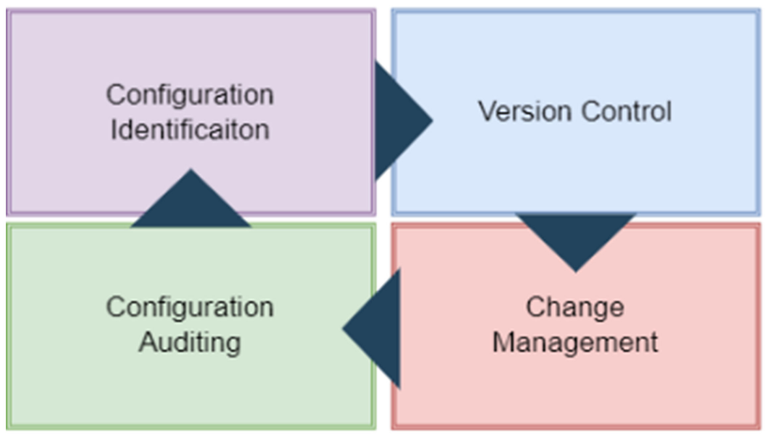
### *Configuration Identification*

The correct management of the configuration for PSG systems at ESS first requires that a system configuration is accurately identified in the initial design phase. This establishes an approved baseline for the system through a detailed documentation strategy. To achieve this each system has the following key documentation types developed and defined in the CIDL

- Concept of Operation (Conops)
- System Requirement Specification (SRS)
- Interface Control Documents (ICDs)
- Detailed Design Specification (DDS) / Electrical Schematics
- Test Specifications (see configuration auditing)




### *Version Control*

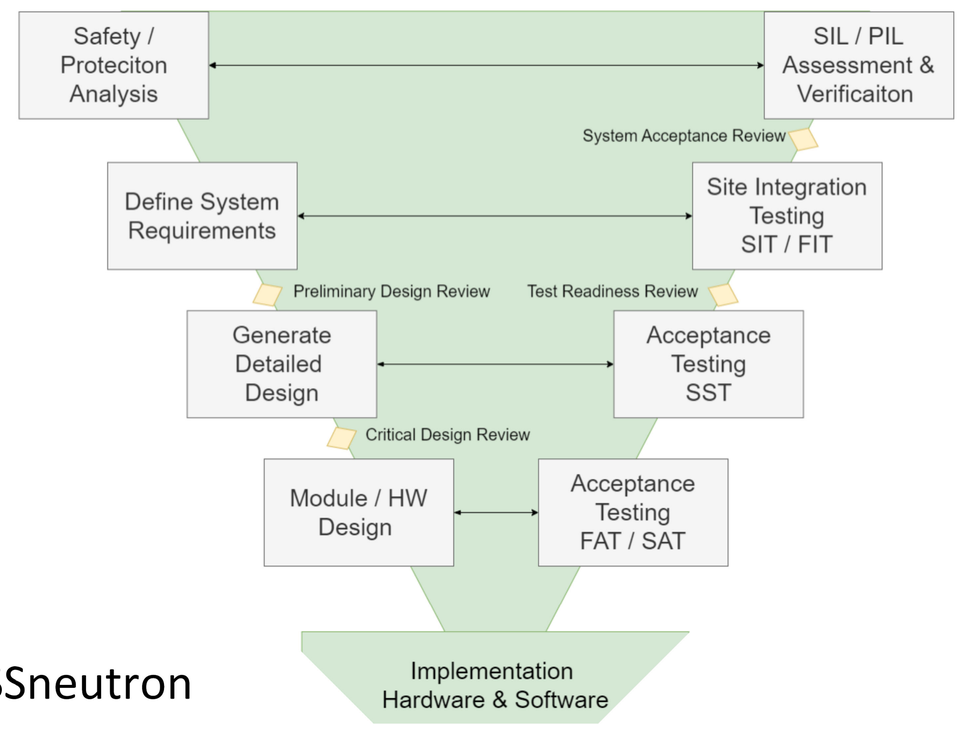
At each stage of development, all versions of software are stored in their official repositories with a versioning comment to indicate the stage of the development. After all verification steps are completed the numbering indicates that the code is production code which matches the functionality as described in the baseline at the time of verification. For the PLC based systems, the checksums of the latest software are also stored in a configuration file which is continuously read and compared against the latest values calculated by the PLC. The system will re-main in a safe state unless these values match preventing unintended operation with a different version of code than what was verified.

### *Configuration Reviews*

Formal reviews ensure that the requirements assigned to the system are sufficient to fulfil the facility needs, then that the system design as defined in the CIDL baseline can fulfil the requirements assigned.

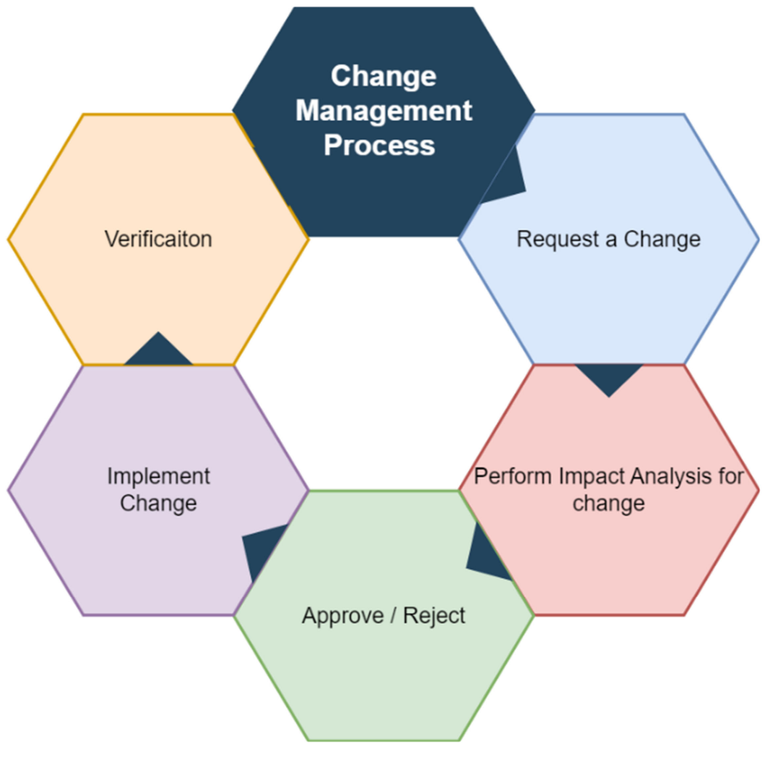
### *System Verification*

System verification ensures that the implemented system matches the identified configuration as defined in the CIDL. This demonstrates that the SRS and DDS have been fulfilled and that the system has been implemented correctly.




### *Change Management*

Changes to the systems shall only be made based on a new requirement and require that an official ESS change control procedure is used. This procedure covers the basic procedural elements of standard change control. A change request is created, all affected systems and stakeholders are identified, an impact assessment is performed, the change is approved or rejected by all stakeholders, only then is the change implemented and verified. This process can prevent unintended effects from uncontrolled or non reviewed changes.

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